XVIII. *On the first Changes in the Ova of the Mammifera in consequence of Impregnation, and on the Mode of Origin of the Chorion.* *By* THOMAS WHARTON JONES, *Esq.* *Communicated by* RICHARD OWEN, *Esq. F.R.S.*

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PART I.—*On the Changes in the Envelopes.*

HAVING previously described the structure of the ovum of mammiferous animals, as it exists in the ovary before impregnation*, I now proceed to relate some facts respecting the changes which it undergoes in consequence of that act.

My observations in reference to this point are the following.

Observation 1.—On Wednesday the 16th, and Thursday the 17th September, 1835, I examined the internal organs of generation of a Rabbit, which had been impregnated on the afternoon of the Saturday preceding, and which was killed on the afternoon of Tuesday. The ovaries of both sides presented corpora lutea.

In the Fallopian tube of the right side, near where it enters the horn of the uterus, I found six ova. In the same place on the left side there were only two. They differed very remarkably from the ova as they exist in the ovaries before impregnation, inasmuch as the former presented, in addition to the component parts of the ovum of the ovary, a thick gelatinous matter surrounding it, similar to what is observed in the ovum of the Frog. The addition of this gelatinous envelope made the diameter of the whole body about $\frac{1}{70}$th of an inch. Plate XVI. fig. 1. represents one of these ova magnified 40 diameters, and fig. 2. the ovum of the Frog when recently laid, magnified 2 diameters.

I could not detect the germinal vesicle in the ova in question. The granulary matter of the yelk was coherent. The application of weak vinegar to the ova rendered the yelk transparent. Dilute nitric acid made the superadded gelatinous envelope contract, but by the addition of more water it gradually expanded again.

The question which this observation suggests is, "Where do the ova acquire the additional gelatinous envelope; in the Fallopian tubes or in the ovaries?" The two following observations give the answer, "In the ovaries."

Observation 2.—March 6, 1236. Examined a female Rabbit to-day, 41 hours and 40 minutes after impregnation. There were *no ova* in the horns of the uterus, nor in the Fallopian tubes.

The right ovary presented on its surface a very large and prominent Graafian ve-

* See Lond. and Edin. Phil. Mag. vol. vii. p. 209.

sicle, quite transparent, except at its most projecting point, where there was a spot of blood. I perceived nothing peculiar in the ovum contained in this vesicle. I did not detect a germinal vesicle in it.

Besides this large and prominent Graafian vesicle there were on the surface of the right ovary other five prominent vesicles filled with coagulated blood. At the most projecting point of each of these there was a small whitish mammillary elevation, within which was contained the ovum, surrounded by a transparent gelatinous substance, the same as that described in the preceding observation; only it is to be remarked, that in the Fallopian tubes this gelatinous looking substance had swelled out and acquired a greater diameter than it presented in the ovary. I did not detect a germinal vesicle in the ova forming the subject of this observation.

In the left ovary I found only one vesicle, containing the coagulated blood and the ovum surrounded by the gelatinous looking envelope.

Observation 3.—A Rabbit 48 hours after impregnation presented appearances much the same as the above.

Is any trace of the gelatinous looking envelope of the ovum to be observed before impregnation? In the ova of the Rabbit, &c., before impregnation, the proligerous disc, in which the ovum is imbedded, is observed to be composed of a gelatinous substance interspersed with grains, but as yet there appears no distinctly circumscribed envelope*.

The gelatinous looking envelope of the ovum I have just described must not be confounded with the vitellary membrane of the ovum, which was fully considered in my former paper. The former appears to be analogous to the cortical membrane surrounding the ovum of the *Ornithorhynchus paradoxus*, &c. while still in the ovary, described by Mr. Owen†. That it, and not the vitellary membrane, as I formerly imagined, forms the chorion, will be made evident by the following observations.

I would, however, premise some remarks on the ova of the batrachian reptiles, in order to place in a more striking point of view the circumstances I am about to relate in regard to the ova of the mammifera.

Fig. 2. exhibits the ovum of the Frog magnified 2 diameters. It is composed of a yelk, black on its surface, and whitish inside. The yelk is surrounded by a vitellary membrane, thicker than that of the bird's egg, but thinner in proportion than that of the ova of the mammifera. Outside the vitellary membrane is a gelatinous envelope, which is added in the oviduct, the two preceding parts being formed in the ovary. When the ova are laid the gelatinous envelope rapidly absorbs water, and swells out to great thickness.

* Dr. Karl Krause of Göttingen, however, in a late Number of Müller's Archiv., speaks as if the gelatinous substance really formed a well defined envelope. From his observations on the ovum *before* impregnation he has been led to form much the same opinion regarding the origin of the chorion as is recorded in this memoir.

† Philosophical Transactions, 1834, p. 561.

The ovum of the Newt differs from that of the Frog, inasmuch as the gelatinous-like matter which surrounds the yelk and its membrane is of an oval form, and is somewhat hardened on the surface, so as to form a kind of shell, inside which is a fluid substance, in which the yelk and its membrane can freely revolve and glide from one end to the other. The vitellary membrane is thinner in the Newt than in the Frog. Fig. 3. is the ovum of a Newt, in which development has commenced; magnified rather more than twice.

But what I wish particularly to insist on, in regard to the ova of the batrachian reptiles, and especially of the Newt, is, that when the embryo of the latter has attained a certain size, but still at an early period, the vitellary membrane gives way, and then the embryo is only contained within the cavity of the substance, which is added to the ovum in the oviduct, fig. 4.

In the case of the Frog the vitellary membrane does not give way, until about the time the Tadpole is ready to burst all its envelopes. With the development of the embryo the cavity circumscribed by the vitellary membrane increases to as much as one fifth of an inch in diameter, and always retains its spherical form. There is a limpid fluid in the interior of the vitellary membrane, which seems to serve the purpose of an amniotic fluid, fig. 5.

Observation 4.—March 18 and 19, 1836. Examined a female Rabbit seven days after impregnation. The right ovary presented four corpora lutea, the left ovary two. I found only one ovum in each horn of the uterus; they were about $\frac{1}{50}$th of an inch in diameter*. Fig. 6, magnified 40 diameters.

No vitellary membrane was to be seen. The gelatinous-looking envelope constituted the only covering of the yelk, which now formed a vesicular blastoderma. The cavity of the gelatinous-looking envelope was much larger than the vesicular blastoderma. The inner surface of the gelatinous coat presented what I supposed to be fragments of the vitellary membrane adhering to it.

In both ova the vesicular blastoderma was irregular on one side, that on which I supposed the embryo was about to be developed. It was beginning to present the separation into layers, and had the same peculiar friable globular structure as the blastoderma of the hen's egg.

Observation 5.—This observation, which refers to the human ovum, agrees with that just related in regard to the ovum of the Rabbit.

In the spring of 1836 I examined a small human ovum sent to me to Cork, where I then was, from Glasgow, by Dr. Mackenzie. In his letter to me, dated November 29, 1835, he describes it thus: "A very small human ovum. It came along with the entire decidua from a patient of mine. It lay in the middle of one of the parietes of

* The reason I found but two ova is, perhaps, that from their great transparency they may have escaped notice. The gelatinous coat was so transparent that I could with difficulty see the outline of it under the glass when it was observed by transmitted light. The vesicular blastoderma being opaque was the only circumstance that enabled me to detect the ova at all.

the decidua, rather near its upper edge, and was about the size of a marrowfat pea, before being put into spirits. The decidua covering it, towards the hydroperionic cavity, was thin and semitransparent, but the opposite portion of the decidual nidamentum was thick, and marked with foramina, as if from vessels which had penetrated and adhered to it. Having opened the nidamentum and taken out the ovum, I observed what will immediately strike you, that one side of it was bald and the other shaggy with the villi of the chorion. The bald part lay towards the hydroperionic cavity. A small puncture was made through the chorion, and perhaps through the amnion, by which some fluid escaped: nothing more was attempted. The Fallopian portions of the decidua measured nearly half an inch, and were both entire."

In a subsequent letter Dr. MACKENZIE says, in reference to the age of this ovum, "The ovum in question I consider as three or four weeks old. The lady had missed one menstrual period, and thought herself four weeks gone."

On laying open the ovum, by carefully cutting and reversing the bald side of the chorion, the following appearances (delineated, natural size, in fig. 7.) presented themselves. The whole cavity of the chorion was filled with a fine gelatinous cellular tissue, imbedded in which, towards one extremity of the ovum, was a small round body.

It was evidently the vesicular blastoderma; on being taken out and examined under the microscope it presented the same friable globular structure found in the vesicular blastoderma of the Rabbit in the preceding observation. There was no vitellary membrane to be seen.

From observation 4. it may be inferred, that in the progress of the development of the ovum of the Rabbit the vitellary membrane gives way, as in the ova of the Newt and indeed of many of the oviparous animals; that the gelatinous coat acquired by the ovum in the ovary, and more especially circumscribed and defined after impregnation, constitutes the only covering of the vesicular blastoderma after the giving way of the vitellary membrane; that this gelatinous-looking coat forms the chorion, which in the rodents at a further stage of development presents itself under the form of a thin and transparent membrane, very like the vitellary membrane of the bird's egg, situated immediately outside the non-vascular and reflected layer of the umbilical vesicle.

The conclusions to be drawn regarding the human ovum from observation 5. are the same as the above. The human ovum as regards the vesicular blastoderma was in much the same stage as the ova of the Rabbit seven days after impregnation; the vitellary membrane had disappeared, or been resolved into the gelatinous cellular tissue filling the interior of the chorion; and the embryo had not yet appeared though the vesicular blastoderma was undergoing the preparatory changes. As regards the chorion, the human ovum was more developed than that of the Rabbit, but it is to be remarked that even in an after stage of development the same difference in structure continues to prevail.

Appendix.

I think it right to mention that in the Rabbit which formed the subject of observation 1, I observed the following other points:

Having cut off a piece from the ovarian extremity of the Fallopian tube of the right side, I put it into a glass capsule, and having laid it open, examined its contents with the microscope; I observed among the numerous shreds of the lining mucous membrane a small body, transparent, and of a very peculiar shape. Having succeeded in transferring it from the capsule to a flat plate of glass, and having removed the shreds of membrane, I was enabled to examine it with a stronger power, and see better its very extraordinary form and structure, which are well represented in fig. 8. I had not a micrometer at the time to measure it, but I think it was about $\frac{1}{70}$th of an inch in diameter at its globular extremity. The calculation was made by comparing it with an ovum from the ovary. It revolved through the water when the latter was put in motion, and in doing so the part *a* was forced to turn sometimes to the one side and sometimes to the other.

In the next piece of the Fallopian tube of the same side which I examined, I found a transparent body not quite round, but prominent on one side, and close by the prominent point there was a small oval vesicular projection, fig. 9. There was an appearance of circular lines on it which touched each other at the prominent point; three of the lines were particularly evident, and the prominent point had a brilliant appearance under the microscope.

In the next piece of Fallopian tube examined I found a body, fig. 10, which on the whole resembled the preceding, but as I might say not so far developed.

Could the three bodies described have been blighted ova? They were all about $\frac{1}{70}$th of an inch in diameter, and therefore corresponding in size to the real ova, already described as being found in the same Rabbit.

Part II.—*On the Changes in the Vitellus.*

What I have to communicate in this second part of my memoir is of a much less definite character than that which is given in the first part. From the nature of the subject it in many cases necessarily consists of inferences rather than observed facts. It relates chiefly to the ova of the batrachian reptiles, and is added here merely for the purpose of throwing some light on the changes which take place in the yelk of the ova of the mammifera, previously to the commencement of the evolution of the embryo.

In approaching this subject the first question which presents itself is: "When does the germinal vesicle of the ova of the mammifera disappear, before or after impregnation?" It is known that in birds and reptiles the germinal vesicle disappears before impregnation. In the ova of the Frog, contained in the oviduct, and also in the more advanced of those contained in the ovary, no trace of the germinal vesicle

is to be observed. The black blastoderma surrounds the whole yelk, with the exception of a small spot* on the opposite side to that where the primitive streak appears. In the furthest advanced ova contained in the ovary of the Newt, the blastoderma was formed, and I think I perceived the place where the germinal vesicle had been. As to the ova of the mammifera, I have found many in which there was no germinal vesicle, and which certainly had not been impregnated. It is to be remarked that in such ova the vitelline grains were for the most part coherent and formed the vesicular blastoderma.

It being determined that the disappearance of the germinal vesicle is prior to impregnation and not dependent on it, the next question which arises is "how does the germinal vesicle disappear?" My observations on the ova of the water Newt are the only ones I have which bear upon this question. From what I have observed in them I think the mode of disappearance is the following:

The vesicle, at first imbedded in the substance of the yelk, approaches more and more the surface of it, until it comes to lie immediately underneath the vitellary membrane, in the manner represented in fig. 12. The coat of the vesicle having now become very soft and weak gives way, and the contained fluid is effused on the surrounding surface of the yelk. The coat of the vesicle being of extreme tenuity cannot be seen after it has given way. The small depression in which the vesicle was situate now forms the cicatricula, fig. 13.

I think that the fluid contained in the germinal vesicle being effused gives a degree of consistence to the matter composing the surface of the yelk, and thus promotes the formation of the blastoderma.

If then the germinal vesicle is not dependent on impregnation, it may be asked, what is the first change which takes place in the ova in consequence of impregnation? Of all ova the ova of the Frog are those in which such change can be most directly observed. In them *the breaking up of the surface of the yelk into crystalline forms*, described by Prévost, and Dumas, is the first change I have seen.

March 17th, 1835. I examined to-day the spawn taken from a Frog yesterday, part of which was impregnated and part not; that which was impregnated presented the appearance delineated in fig. 11. The unimpregnated ova presented no change. The surface of the yelk becomes every day still more broken up, the crystalline forms becoming smaller and smaller, until the surface of the black blastoderma appears under a magnifying glass like shagreen. The blastoderma, consisting of an aggregation of clear globules, different from those of the rest of the yelk, is now fully

* This small spot of the ova of the frog which is white, (from the exposure of the white yelk,) always turns to the most depending side. The germinal point is thus always uppermost. I turned a mass of spawn upside down; the white spot was exhibited by all, but in a short time the white spot had turned downwards and the germinal surface again became uppermost. In this case, does the vitellus alone revolve, or does the vitellus and its membrane turn round together in the gelatinous substance surrounding the ovum? It appeared to me that the latter was the way in which the revolution took place.

formed; it has extended itself so as to close in the white spot. Evolution then proceeds.

The change which takes place in the yelk of the bird's egg appears to be limited to the neighbourhood of the cicatricula. In the ovum of the mammifera, there being little more than a blastoderma to be formed, the whole of the vitelline grains undergo a change, and are resolved into a vesicular blastoderma, presenting the same peculiar friable and globular texture as the blastoderma of the egg of the Newt, Frog, Bird, &c. The matter contained in the cavity of the yelk of the bird's egg seems to be a substance of the same nature as the blastoderma, and to serve for the extension of it. The blastoderma of the bird's egg being once formed by the effusion of the fluid of the vesicle of PURKINGE, and animated by fecundation, probably has the power to assimilate the matter in the cavity of the yelk to its own substance, without the assistance of a fluid such as that of the vesicle of PURKINGE, which was first required to promote its formation. There is no central cavity in the ova of the Frog and Newt, because the blastoderma is formed at once all round the ovum.

Description of the PLATE.

PLATE XVI.

Fig. 1. An ovum found in the Fallopian tube of a Rabbit the third day after impregnation; magnified forty diameters.

Fig. 2. The ovum of the Frog when recently laid; magnified two diameters.

Fig. 3. The ovum of a water Newt in which development has commenced; magnified rather more than twice.

Fig. 4. A diagram showing the embryo of the Newt after the vitellary membrane has given way, contained only within the cavity of the substance which is added to the ovum in the oviduct.

Fig. 5. A diagram showing the embryo of the Frog still surrounded by the vitellary membrane as well as the gelatinous substance which is added to the ovum in the oviduct.

Fig. 6. An ovum found in the horn of the uterus of a Rabbit seven days after impregnation; magnified forty diameters.

Fig. 7. A human ovum aborted at the third or fourth week; natural size.

Figs. 8, 9, 10. Bodies found in the right Fallopian tube of the Rabbit which forms the subject of observation 1; magnified about fourteen diameters.

Fig. 11. This exhibits the breaking up into crystalline forms, observed on the surface of the Frog's ovum after impregnation; magnified about six diameters.

Fig. 12, 13. Diagrams illustrating the mode of disappearance of the germinal vesicle.